

by

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A sub-miniature, solid-state, unity-gain preamplifier suitable for use with both metallic and micropipet micro-electrodes has been developed and has been used to obtain evoked responses from single cells. Records taken show a performance comparable with the best vacuum-tube preamplifiers in current use. It is capable of low-noise operation when used with high source impedances and has an input resistance large compared with the electrode resistance. Since rapid changes in potential are to be recorded, the input capacitance is kept low enough to minimize the filtering effects of the series resistance of the electrode and the shunt capacity of the input circuit.

In the circuit diagram shown, Q1 is a field effect transistor employed as a source follower, which provides both a high input resistance and low-noise operation with large electrode resistances.

There remain the problems of reducing the input capacitance and preventing the gate bias resistor R3 from shunting the high resistance of the field effect transistor. Both these problems are solved by bootstrapping, which involves ensuring that if one side of a capacitor or resistor changes in potential the other side experiences a similar change. In this way current flow into the capacitor or resistor is much smaller than it would have been otherwise and the effective capacitance is reduced, while the effective resistance is increased.

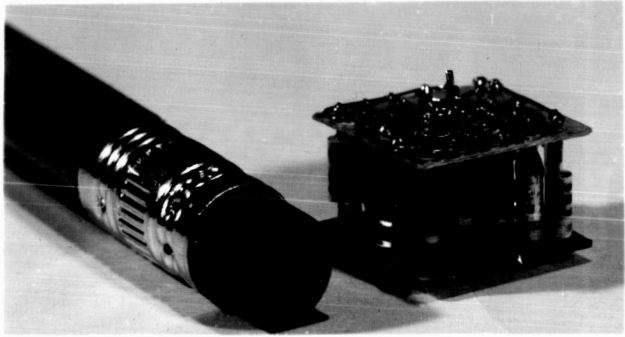
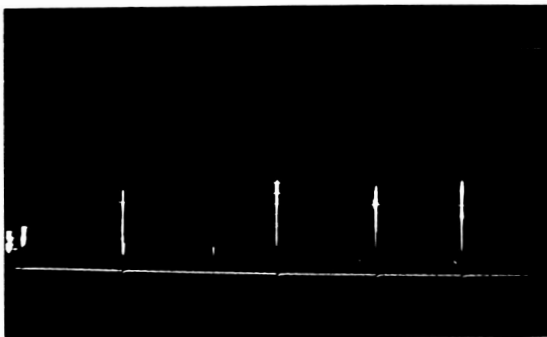
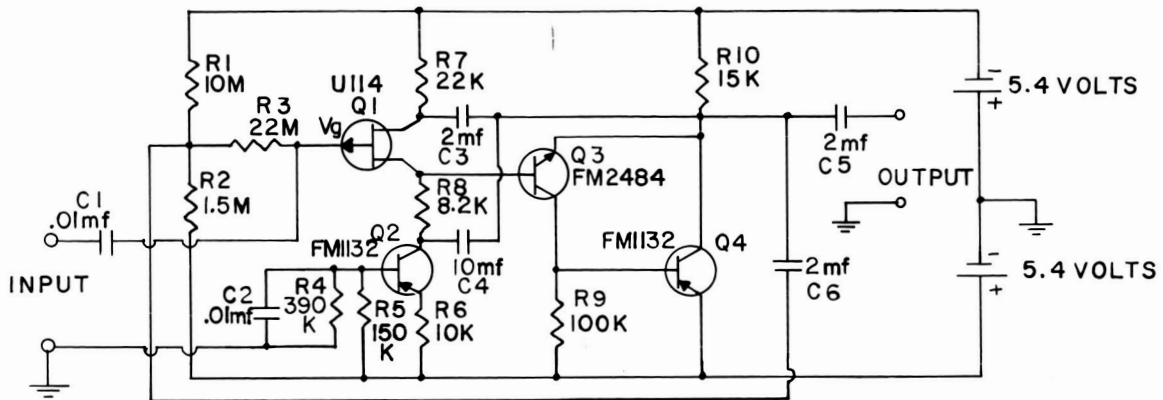
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A photograph of the preamplifier and a sample record, an intracellular recording from a vestibular nucleus in a frog during head tilting, are shown in the figure.

In order to further improve the recording of rapidly changing potentials, a preamplifier with a negative input capacitance is being developed.



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Micro-electrode field effect preamplifier. Record is an intracellular recording from a vestibular nucleus in a frog during head tilting.